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A potential correlation between dengue and the temperature of the Pacific Ocean yielding an additional warning sign

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ABSTRACT

At the present time, an El Niño phenomenon in 2012 along with a possible increase in ocean temperature is witnessed, the consequence of which might generate an epidemic of the disease: dengue. An implementation of a warning epidemiological surveillance based on the monitoring of the surface temperature of the Pacific Ocean and Google Trends concerning dengue could have an influence on public health policies.

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Epidemiological surveillance is characterized by determining the risk that a population may encounter for a particular disease through the collection, analysis and interpretation of specific data about diseases that pose a risk to the health of this population. An examination of the disease dengue and the temperature of the Pacific Ocean is presented to ascertain if there is any possible correlation which could yield predictive warning signs.

At the present time, surveillance systems for the understanding of diseases are based on data from the morbidity and mortality public health records for such diseases as cholera, dengue and chagas. With this information, it is possible to suggest priorities for their prevention and control along with alerting the population in the vulnerable area.

The present work, based on a preliminary analysis, suggests that it might be possible to generate an early warning system against the disease dengue by monitoring the temperature of the Pacific Ocean using monthly updated data from the National Oceanic Atmospheric Administration (NOAA). This could be also applied to

other diseases that are transmitted by means of vectors. In the case of dengue fever, it is worth mentioning that it is presently reemerging and it is estimated that 40% of the population could get this disease^[1]. It is transmitted by the *Aedes aegypti* and *Aedes albopictus* mosquitoes whose offspring often reside in stored or unused water reservoirs. To date, the epidemiological risk reappears periodically. It has been correlated with the frequency of epidemics associated with the El Niño climatic phenomenon^[2,3]. A correlation of the influenza virus^[4] and dengue^[5] has also been suggested.

The data that was used in these works was obtained using Google Trends capability available at www.google.org/denguetrends. Another indicator is the presence of cholera cases derived from problems of water pollution^[6,7]. There appears to be a correlation that the effect of El Niño is closely linked to cholera cases and this disease is very common in countries in the tropics; thus, it should be mentioned the episode that occurred in 2006 in Angola, which followed the rains left by El Niño caused the death of 3000 people.

Comments and Responses

By monitoring the surface temperature of the Pacific Ocean (available at www.cpc.ncep.noaa.gov/) in the region called Niño4, it is possible to find at the present time that there is an increase in temperature which now exceeds 28°C from the 15th week in 2012 and keeps rising (see Figure 1b), which could lead to the presence of the El Niño phenomenon in this year.

In addition, the number of cases of dengue in Venezuela from the 14th week in 2012 has continuously increased (see Figure 1a). An examination of the values from Google Trends on dengue reveals a similar behavior. In fact, in determining the Spearman correlation coefficient (R) based on the null hypothesis, data from Google Trends and cases of dengue from the 13th week in 2012, a value of $R = 0.76$ is obtained which indicates that they are related to each other (a value of 1 indicates 100% correlation). Therefore, it can be deduced that the values obtained from the Google index trends reflect the behavior of the dengue cases reported in Venezuela.

Moreover, in determining the value of R between the data from Google Trends and the temperature measured in the region Niño4 in the Pacific Ocean, a higher correlation value than that of the previous paragraph is obtained ($R = 0.83$, see Figure 1b), which shows that cases of dengue measured by Google Trends are influenced by the temperature of the Pacific Ocean^[2].

It is also worth mentioning the available tools for the online detection and quantification of epidemics^[8]. By means of the analysis of health care data and statistical periodic regression models, it is possible to detect outbreaks and estimate epidemic burdens if a theoretical threshold is reached in the periodic baseline, which requires a period of several years to be calculated. Using this technique with the Google Trends from 2006 until 2012 for dengue (data not shown), a value of 0.31 is obtained and at present is only 0.2. Therefore, it is necessary to keep alive the integrated strategy to manage dengue in Venezuela so any further outbreak could be previously detected. In this sense, the quantitative effect of the temperature of the Pacific Ocean on the disease will be better evaluated.

Finally, as noted by the Pan American Health Organization, there have been over 570,000 cases of cholera in Haiti until 10 July 2012, with more than 7,000 deaths, while in Cuba, only 58 cases and 3 deaths have been reported to that date. This suggests that we may be facing the occurrence of an El Niño in 2012, and

early prevention campaigns and epidemiological alerts in Venezuela should be made.

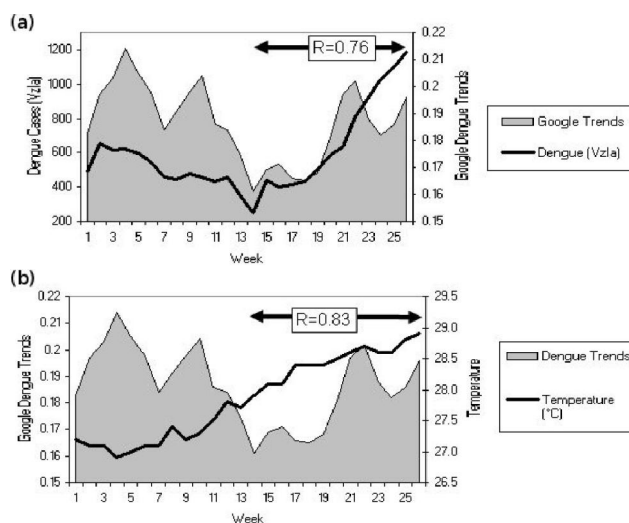


Figure 1 : (a) The number of reported cases of dengue fever by the government health agency in Venezuela are shown; data were obtained from the epidemiological alert bulletin (represented by a solid line) and the index of Google Trends about dengue (area), in 2012 from the 1st week to the 26th. (b) The temperature (solid line) is depicted jointly with the google trends index (area) in the same period. Also shown in the top right, the spearman correlation values in the range from the 13th to the 26th weeks

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